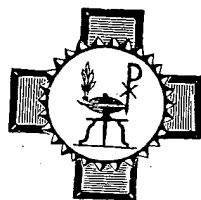


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PREHISTORIC IRRIGATION IN THE NAVAHO DESERT

IT has not been established that irrigation in anything more than a very rudimentary form was generally practiced by the aboriginal inhabitants of the arid sections of our Southwest prior to the Spanish invasion. The practice of impounding the drainage of small catchment basins in natural depressions and artificial ponds by the construction of dams of earth and stone was common wherever the Pueblo mode of life prevailed, but in only a few localities have remains been found that point to anything like a *system* or irrigation. That a well-developed system existed in the Gila drainage has been fully established. The remains of canals of great extent in the Gila and Salado valleys, capable of irrigating a vast area, have been described by Hodge,* and extensive works in the Verde Valley were described by Mindeleff.† These observations have the support of such eminent authorities as Cushing and Bandelier. These remains have rapidly disappeared with the advance of agriculture in recent years, but the observations mentioned, made while the remains were in a fair state of preservation, leave no question as to the existence and great extent of these works, while their prehistoric character seems to be equally well established. In these valleys the waters of the rivers were taken out

* *Prehistoric Irrigation in Arizona*, by F. W. Hodge; *American Anthropologist*, July, 1893.

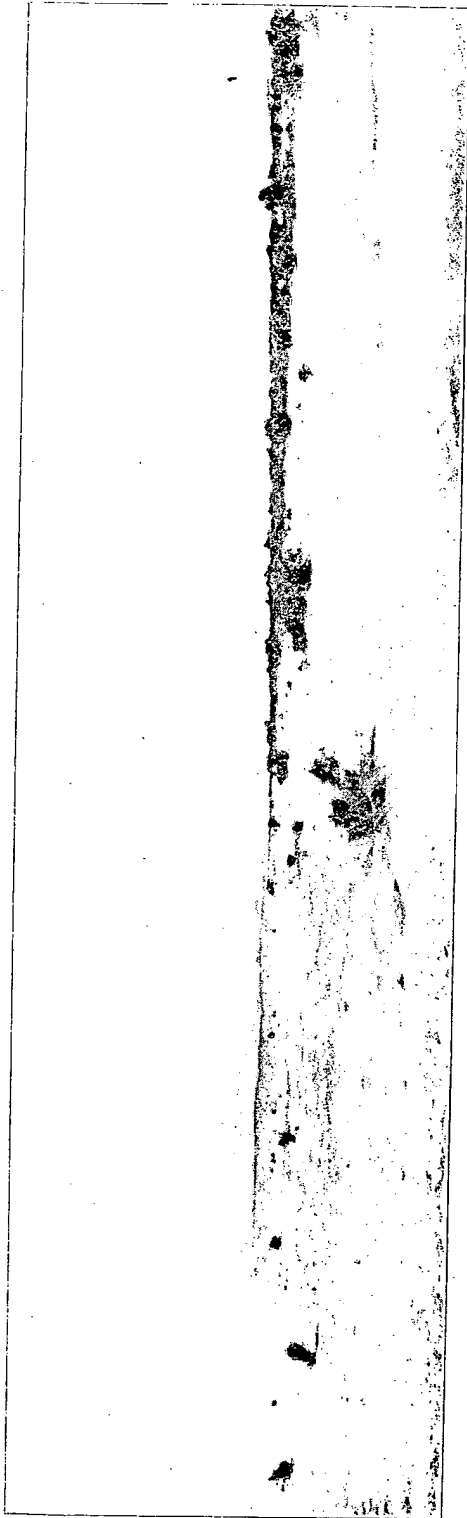
† *Aboriginal Remains in the Verde Valley, Arizona*, by Cosmos Mindeleff, *13th Ann. Rep. Bur. of Amer. Ethnology*.

through well built canals, conducted for many miles and distributed by means of laterals over large areas. No higher development of the science of irrigation was reached in prehistoric America, and, indeed, it is doubtful if any people of the Old World practiced irrigation on a larger scale or by a more perfect system as early as the XV Century.

It seems certain, however, that no such system existed anywhere within the present limits of the United States outside of the Gila drainage. In the Rio Grande Valley only the most rudimentary form of irrigation was practiced. Small reservoirs are found in conjunction with almost every pueblo ruin. These evidently served to impound the waters of flood seasons for domestic use, and also for the purpose of watering small fields, but at best they could have served only slightly to supplement the natural rainfall. In places small ditches are found extending from the mountain sides into the valleys evidently designed to divert the waters of mountain torrents to irrigable fields. I know of none of these of any considerable extent save one at Puye on the Pajarito plateau in New Mexico. Here a large, well constructed ditch, originating in a catchment basin of considerable area, west of Puye Mesa, is carried along the hillside a few feet above the bed of the dry Puye arroyo for a distance of over two miles to the level plain east of the ancient village site. It cannot be established, however, that this is work of the prehistoric period. It is well known that the Puye pueblo and cliff village was reoccupied by the Santa Clara Indians late in the XVII Century, after having been long abandoned, and after the Spanish system of irrigation had been introduced among the Rio Grande Pueblos.

Irrigation was perhaps equally developed in the Little Colorado drainage in pre-Spanish times and may have reached a somewhat higher plane in the San Juan Valley. The remains of rather extensive works have been reported from time to time in the latter region, but these have for the most part been destroyed in recent years.

A totally unlooked for development of irrigation works was observed by the writer in the midst of the Navaho Desert in northwestern New Mexico while on a brief reconnoissance of the ruins of Chaco Canyon and its environs. The character of this desert may best be observed by entering it from the eastern side by the way of Jemez. It may be entered more easily from the northwest by way of Farmington or from the southwest by way of Gallup or Thoreau. Entering by way of Jemez, the last stream of any consequence that is crossed is the Puerco, and this is by no means permanent. At the Torreon, a few miles further west, water is retained in holes during the greater part of the year. Beyond this, vegetation quickly disappears and absolute desert is encountered. For the next hundred miles or so, a more barren waste cannot be pictured by the imagination. There are vast stretches where no living objects, not even the ordinary desert plants, are to be found. A loaded wagon sinks half hub deep in the grayish-yellow sand, the wheels leaving great furrows which, however, are filled by the wind



NAVAHO DESERT SCENES

within a few minutes, leaving the trail completely obliterated. The horizon line is usually relieved by long elevations of table-land, or abrupt, isolated buttes which loom up in the clear atmosphere, forming sometimes the only landmark for an entire day's travel. There are places where the entire horizon is unbroken, where there is not a tree, bush, hummock, undulation or mark of any sort, where the wind immediately obliterates all tracks and the traveler must steer by the compass.

In the midst of the appalling waste, about 90 miles northwest of Jemez, is the famous Chaco Canyon group of ruins. They extend for a distance of about 30 miles along the dry wash of the Chaco and form the most imposing group of ruins in the Pueblo region. Not all the large ruins of the group are in the narrow valley of the Chaco, nor on the mesas immediately overlooking it. Several of the most important lie in the desert some miles to the south of the Chaco and it is about these that ancient irrigation works are most conspicuous.

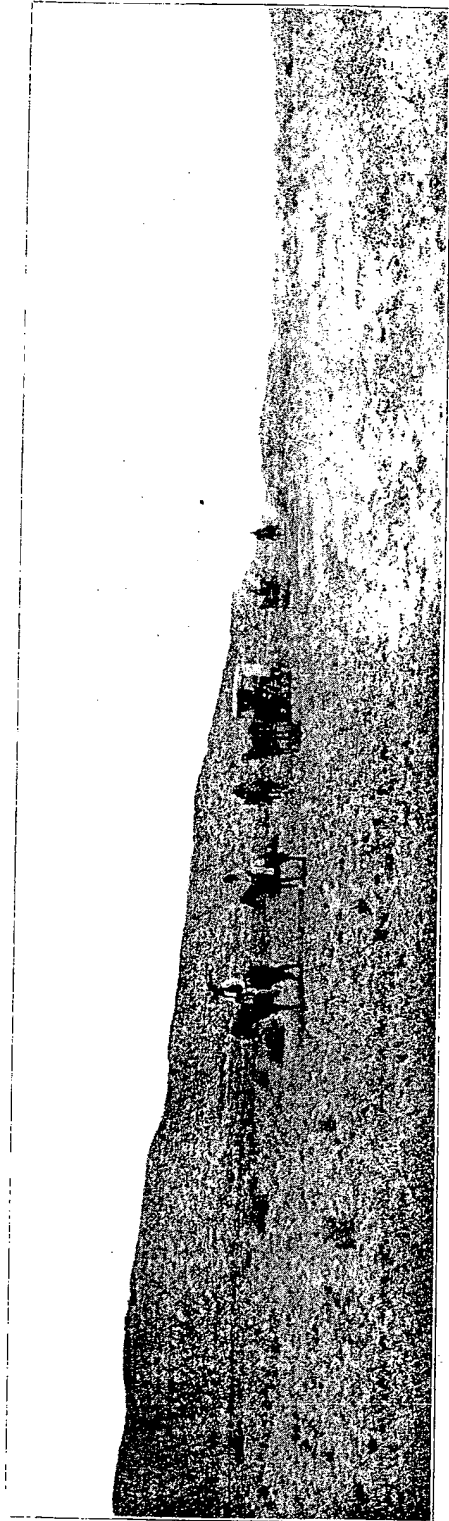
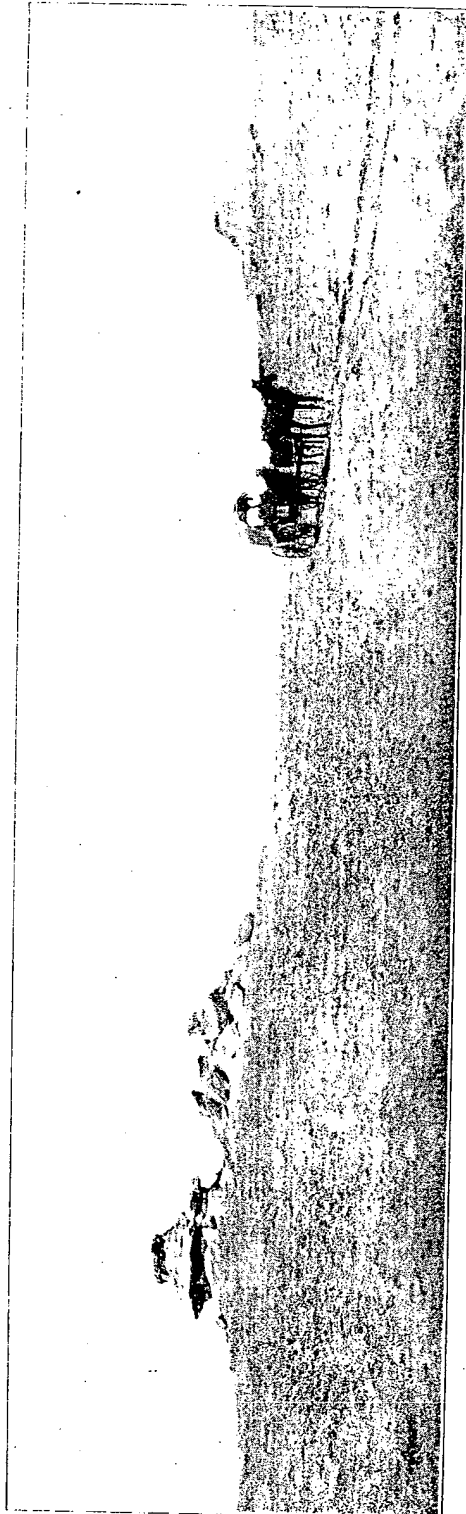
The best preserved works in the canyon are at Una Vida, two miles above Pueblo Bonito, and those belonging to the pueblo of Penasco Blanco, three miles below Bonito. Near Una Vida, which is situated against the north wall of the canyon, a reservoir and system of ditches is discernible. Penasco Blanco is situated on top of the mesa south of the canyon. Its fields lay in the bottom north of the Pueblo. No great area was cultivated and it is difficult to understand now how such a sea of land could ever have produced sustenance for such a large community. The reservoir was built in a bed of sand where seepage would naturally have been so great as to render it useless. This was overcome, at least partially, by lining the bottom with clay and slabs of stone. This clay when indurated formed a moderately good cement and rendered the reservoir fairly effective. The waters from the main channel of the Chaco were diverted by means of a weir and conducted to the reservoir. Seepage in the weir was overcome by the same method as in the reservoir.

Kinklizhin is a large ruin on the mesa between 7 and 8 miles southwest of Pueblo Bonito. Here are fairly well preserved irrigation works. The pueblo stands on a sandy hill. About 1/8 mile away is a broad wash and in this are well preserved remains of a stone dam. On the east side is a waste-way cut through the solid rock. The reservoir was large enough to impound a meager supply of water for the irrigation of the fields cultivated by the pueblo. These consisted of about 200 acres. The ditch which conducted the water from the reservoir to the fields is quite filled with sand but plainly discernible.

The best example of irrigation works in the entire Chaco system is that at Kinbineola. This ruin is about 15 miles southwest of Pueblo Bonito. The ruin is in the basin of a wash of the same name which is tributary to Chaco Canyon. The valley is here quite broad and on the eastern side is limited by a low mesa, at the base of which stand the



RUINS OF KINBINEOLA (THE HOUSE OF THE WINDS)



NAVAHO DESERT SCENES

ruins of the pueblo. The wash is about $\frac{1}{3}$ mile to the west. South of the ruins is a large natural depression, which was made to serve as a reservoir for the flood waters diverted from the wash. A ditch fully two miles long conducted the water from this lake to the fields, which were quite extensive. The ditch is carried around the mesa and along a series of sand hills on a fairly uniform grade. The ditch was mainly earthwork, but whenever necessary the lower border was reinforced with retaining walls of stone, portions of which still remain in place.

I am informed that at Kinyaah, a small ruin 40 miles south of Chaco Canyon, there are vestiges of an irrigation system. This ruin is situated on an open plain, surrounded by a large area of irrigable land. The works consist of two large reservoirs and a large canal 25 ft. to 30 ft. wide and in places 3 ft. or 4 ft. deep.

The observations above reported do not constitute an attempt at a complete description of irrigation as practiced by the inhabitants of the Chaco Canyon group of pueblos.

These are some of the results of mere casual reconnoissance. They are put down here to point out the existence of a system of prehistoric irrigation in the midst of the Navaho Desert that is intermediate in its plane of development between the advanced system of the Gila drainage and the very rudimentary form common to the entire pueblo region. It represents but modest achievement as compared with that of the Gila people, but marked advance over the common achievements of the prehistoric pueblos.

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ARCHAEOLOGICAL NOTES FROM SWEDEN

THE physical geography of Skåne, the southern province of Sweden, is almost identical with that of Denmark and originally it belonged to Denmark. Nowhere does the land rise more than a few hundred feet above the sea and much of it is below 200 ft. It is entirely covered with glacial deposits and much of it with distinct moraine accumulations, in the midst of which bogs and kettle holes abound. Many of the summits of the low hills are surmounted by mounds or tumuli from 20 to 50 ft. in height. These mark the burial places of the ancient Vikings. Some of them have been excavated and found to contain, in addition to the human bones, stone and bronze implements, showing that they belonged to the closing period of the Bronze Age. It is known that at a later time the tribes practiced cremation; but these burials took place before that period. From all these considerations it is reasonably inferred that the mounds date back about 4,000 years.